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(54) FABRIC WITH REVERSIBLE ENHANCED THERMAL PROPERTIES

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TISSU PRESENTANT DES PROPRIETES THERMIQUES REVERSIBLES AMELIOREES

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(73) Proprietor:
TRIANGLE RESEARCH AND DEVELOPMENT CORPORATION
Raleigh, NC 27612 (US)

(72) Inventors:
- **BRYANT, Yvonne, G.**
  Raleigh, NC 27610 (US)
- **COLVIN, David, P.**
  Apex, NC 27502 (US)

(74) Representative:
Schmitz, Jean-Marie et al
Dennemeyer & Associates Sàrl
P.O. Box 1502
1015 Luxembourg (LU)

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Description

The present invention comprises a coating according to the precharacterizing portion of claim 1, an article according to the precharacterizing portion of claim 8 and a method of improving the thermal capacity of a fabric or fiber substrate.

This invention relates generally to the field of coated fabrics and more particularly to fabrics coated with a binder containing microcapsules filled with energy absorbing phase change material which enables the fabric to exhibit extended or enhanced heat retention or storage properties.

The treatment of textiles with various substances in order to change the properties thereof is well known. For example, it is known that textiles may be waterproofed by coating them with natural or synthetic rubber. Substances have been developed which when sprayed onto fabrics introduce the property of stain resistance. Also known is the example of a fragrance delivery system which uses breakable fragrance-filled microcapsules which are attached to the surface of a fabric or fiber and upon the introduction of an external force, the microcapsules break releasing the fragrance over an extended time period.

Other examples of microcapsules being applied to the surface of fabrics for various end-uses are known. US-A-4,774,133 to Doree et al. discloses a thermoplastic substrate bearing rupturable microcapsules in a binder. The substrate is capable of being softened when heated, and by the application of pressure the microcapsules become partially imbedded in the surface of porous objects such as fabrics. A thermo-adhesive textile product is disclosed in US-A-4,990,392 and comprises a backing fabric and an adhesive layer deposited on its surface. The adhesive layer comprises a thermo-adhesive polymer and a cross-linking agent which is isolated from the polymer by microencapsulation and which is freed by external action. The present invention differs from the forgoing examples in that the microcapsules contain phase change material and are designed to be an integral and permanent part of a coating applied to a substrate, as opposed to being ruptured during use.

Fabrics have been given enhanced thermal properties by coating the fibers with phase change material and plastic crystals. US-A-4,871,615 discloses temperature adaptable textile fibers which store heat when the temperature rises and release heat when the temperature decreases, in which phase change or plastic crystalline materials are enclosed within hollow fibers or impregnated upon non-hollow fibers. The fibers are produced by dissolving the phase change or plastic crystalline materials in a solvent such as water,thereafter filling the hollow fibers, or impregnating the non-hollow fibers, with the solution, followed by removal of the solvent. Alternatively, the phase materials may be applied to the fibers from a melt rather than a solution.

The US-A-4 747 240 describes an inorganic cementitious interior building material comprising primarily inorganic material and including a cementitious ingredient for binding together all of the elements and dispersed therein small particles of a phase change material.

At the phase change temperature, a characteristic of phase change material during the heating cycle is to absorb and hold a quantity of thermal energy at almost a constant temperature while changing to the next phase. Thus, the material can be precooled and used as a barrier to heat, since a quantity of thermal energy must be absorbed by the phase change material before its temperature can rise. The phase change material before its temperature can begin to drop.

However, the durability of the aforementioned surface mounted phase change materials was found to be lacking. While somewhat effective, the fabric lacked repeatability of the thermal response. Each successive laundering removed a portion of the phase change material, thus causing the fabric to exhibit a corresponding change in thermal properties which limited its usefulness and lifetime. As a result, further work was undertaken to perfect a series of process steps for binding the phase change material to the fabric in order to extend the useful life of the enhanced thermal properties. Furthermore, as far as is known to the inventors, these fibers and fabrics have limited usefulness as only a single phase change material may be applied to the substrate which requires that the thermal absorption or release occur at a specific temperature.

It is, therefore, an object of the present invention to provide a substrate coating with enhanced thermal retention properties.

It is another object of the present invention to provide a substrate coating which will maintain its enhanced thermal properties over an extended period of time.

It is another object of the invention to provide a substrate coating having enhanced thermal properties which can be produced with a minimum of process steps.

It is a still further object of the present invention to provide a substrate coating having enhanced thermal properties which can be applied to a fabric from which articles of clothing and the like can be manufactured.

It is a still further object of the present invention to provide a substrate coating which displays enhanced thermal properties over a specified temperature range.

A related object of the present invention is to provide a thermal control material having enhanced thermal storage properties that are reversible.

The coating of the present invention is defined in the characterizing portion of claim 1, the article of the present invention is defined in the characterizing portion of claim 8 and the method of improving the thermal capacity of a fabric or fiber substrate is defined in the characterizing portion of claim 23.

The foregoing objects are accomplished by providing a coating adapted to be applied to a substrate such as a fabric for enhancing the thermal storage properties thereof. The coating comprises a polymer binder and a plurality of leak resistant microcapsules, integral with and dispersed throughout the polymer. The microcapsules contain a temperature stabilizing means such as a phase change material. A substrate coated with the object of the present invention exhibits enhanced thermal stability when subjected to heat or cold. The microcapsules are resistant to leakage or rupture and may be subjected to repeated external mechanical stresses with minimum changes in the thermal characteristics of the coated substrate. Additionally, the coating may also include microcapsules containing different preselected phase change materials with different transition temperatures, which increases the range of temperatures over which the coated substrate can be stabilized.

In order that the invention may be fully understood reference is made on the accompanying drawings wherein:

Figure 1 is a cross section of a microcapsule according to the present invention containing phase change material.
Figure 2 is a perspective view of a substrate coated with a polymer coating microcapsule according to the present invention.
Figure 3 is a sectional view of a substrate coated on one side according to the present invention.
Figure 4 is another perspective view of a coated substrate according to the present invention.
Figure 5 is a cross-sectional view of the substrate according to the present invention taken along line 3-3 of Figure 4.

While the present invention will be described more fully hereinafter, it is to be understood at the outset that persons of skill in the art may modify the invention herein described while still achieving the favorable results of this invention. Accordingly, the description which follows is to be understood as being a broad teaching disclosure directed to persons of skill in the appropriate arts, and not as limiting upon the present invention.

Referring now to the drawings and particularly to Figures 2 and 4, the coating generally indicated at 10 comprises a flexible polymer binder 20, with a plurality of microcapsules 30 (Fig. 1) integral and dispersed throughout the polymer binder 20. The microcapsules 30 contain a temperature stabilizing means 40 as will be more fully explained hereinafter.

The polymer binder may take the form of an organic plastic, examples of which include, but are not limited to, polyurethane, nitrile rubbers, chloroprene rubbers, polyvinyl alcohol, silicone, ethylene/vinyl acetate copolymer, acrylic and the like.

The microcapsules 30 can range in size from about 0.5 to 1,000 µm(microns)and are formed according to conventional methods well known to those skilled in the art.

The microcapsules contain a temperature stabilizing means or phase change material 40 such as eicosane. Additionally, plastic crystals such as 2,2-dimethyl-1,3-propanediol (DMP) and 2-hydroxymethyl-2-methyl-1,3-propanediol (HMP) and the like may be used as the temperature stabilizing means. When plastic crystals absorb thermal energy, the molecular structure is temporarily modified without changing the phase of the material.

In another aspect of the invention, the composition of the phase change material 40 may be modified to obtain optimum thermal properties for a given temperature range. For example, the melting point of a homologous series of paraffinic hydrocarbons is directly related to the number of carbon atoms as shown in the following table:

Compound Name	Number of Carbon Atoms	Melting Point ° Centigrade
n-Octacosane	28	61.4
n-Heptacosane	27	59.0
n-Hexacosane	26	56.4
n-Pentacosane	25	53.7
n-Tetracosane	24	50.9
n-Tricosane	23	47.6
n-Docosane	22	44.4
n-Heneicosane	21	40.5
n-Eicosane	20	36.8
n-Nonadecane	19	32.1
n-Octadecane	18	28.2
n-Heptadecane	17	22.0
n-Hexadecane	16	18.2
n-Pentadecane	15	10.0
n-Tetradecane	14	5.9
n-Tridecane	13	-5.5

Each of the above materials can be separately encapsulated and is most effective near the melting point indicated. It will be seen from the foregoing that the effective temperature of the coating can be tailored to a specific environment by selecting the phase change materials required for the corresponding temperature and adding microcapsules containing the material to the coating.

In fabricating the coating 10, the desired microencapsulated phase change materials are added to the polymer binder (liquid, solution or dispersion), compounded, cured, cross-linked or foamed to form a flexible layer on a substrate such as a fabric according to conventional coating methods. Typical concentrations of microencapsulated phase change material 30 added to the polymer binder range from about 30% to about 80% by weight. Embedding the microcapsules directly within the polymer binder 20 adds durability as the phase change material is protected by a dual wall, the first being the wall of the microcapsule and the second being the surrounding polymer matrix itself. Thus, the phase change material is less likely to leak from the coating during its liquid phase, thus enhancing its life and repeatability of thermal response.

The base material or substrate 50 can be an individual fiber, fabric (woven, knitted or non-woven) or non-fabric (molded objects). A significant element of the present invention is the continuous (webbed) or discontinuous (non-webbed) nature of the coating. Depending on fabric construction and viscosity of the coating medium, a discontinuously coated substrate 50 can be formed in which the individual elements of the substrate are each covered and not connected, as distinguished from a continuous coating in which the individual elements of the substrate 50 are connected by webbing of the coating matrix. Loose fabric construction coupled with a low viscosity coating medium yields the non-webbed structure, whereas tight fabric construction and high viscosity coating medium yields a coating with the webbed structure. In addition, individual fibers, Figures 4 and 5, can be coated before conversion into a product.

In one embodiment of the invention, the binder with microcapsules is sprayed onto a substrate. A polyurethane containing polytetramethyleneglycol ether reacted with methylene diphenylene diisocyanate is the preferable polymer binder. The polyurethane is a solvent-based polyurethane with a preferred concentration of 35% solids to 65% solvent, the solvent being comprised of 65% dimethylformamide, 25% toluene and 10% methyl ethyl ketone. One such polyurethane is BC-400™ obtained from Polyurethane Specialties Co., Inc. of Lyndhurst, New Jersey. To the polyurethane are added microcapsules having an average diameter of from 10 to 60 microns, core material comprised of 99% octadecane, and a microcapsule wall comprised of an amino/formaldehyde polymer. Microcapsules such as these may be obtained Microtek Laboratories, Inc. of Dayton, Ohio. The mixture preferably contains equal parts by weight of the microcapsules and the polyurethane and is mixed manually until the microcapsules are substantially evenly dispersed

throughout the polyurethane. Thereafter, the mixture is sprayed to a nonwoven fabric substrate, preferably Hollofil®, manufactured by E.I. du Pont de Nemours Company. The mixture is sprayed to that dry thickness which will result in a 50% increase in dry weight of the fabric. When analyzed by differential scanning calorimetry over the range of 5° to 100° C., the resulting fabric has been shown to contain approximately 75 Joules per gram of latent specific heat.

An important aspect of the present invention is its capability of imparting a thermal barrier effect to heat transfer for temperatures in the phase change range to coated fabric substrates. The significance of which derives from the capability of the present invention to store latent heat thereby limiting heat loss or heat gain. At the phase change temperature, a characteristic of the material during the heating cycle is to absorb and hold a quantity of thermal energy at almost constant temperature while changing to the next phase. The phase change material acts like "infinite" insulation when it is charging at the phase change point. It acts like an auxiliary heater when discharging at the phase change point. This action is transient, i.e., it will be effective until the total latent phase energy is either exhausted (on cooling) or absorbed (on heating). This function goes far beyond ordinary insulation which has no phase change mechanism. These heat storage and transfer properties do not suffer degradation in thermal performance when the coated fabric is compressed, as experienced by materials which solely depend upon insulative-trapped air for their barrier properties.

In another important aspect of the invention, clothing with thermal barrier properties can be fabricated from coated fabric substrates. The latent energy stored in the phase change material can be "recharged" by metabolic heat production during high activity levels, as well as by an external heat source applied prior to use. For example, a protective glove-liner can be made form a coated fabric. With the appropriate phase change material, the glove-liner can be adapted for cold weather use. The glove-liner can be heated prior to use to saturate the latent energy storage of the phase change material. It will remain warm for an extended period of time, with substantial cooling not occurring until the liquid phase change material has solidified, the length of time depending upon the metabolic activity of the user and the external temperature. Conversely, by selecting the appropriate phase change material, the glove-liner can be used to handle hot objects. In this instance, the phase change material is applied in the "cooled" state. When exposed to a hot environment, the user will remain comfortable until the phase change material has changed state.

Furthermore, the usefulness of the coating may be extended by using microcapsules containing two or more different phase change materials. Thus, by proper selection, a glove may be designed to protect the hand of the wearer when grasping hot objects and to similarly warm the hand of the user when out in a cold environment. It will be noted that this effect is reversible. The concept can be applied to items of clothing such as shoes, environmental suits, and numerous other applications which require protecting individuals or machinery from the hot or cold.

The foregoing embodiments and examples are to be considered illustrative, rather than restrictive of the invention, and those modifications which come within the meaning and equivalence of the claims are to be included therein.

Claims

1. A coating (10) comprising a binder (20) and a plurality of leak resistant microcapsules (30) dispersed throughout said binder (20), said microcapsules (30) containing a temperature stabilizing means (40) characterized in that the coating is adapted to be applied to the surface of a fabric or fiber substrate (50) for enhancing the thermal storage properties thereof and said binder (20) is a liquid polymer binder (20) said microcapsules being submerged within said liquid polymer binder (20) and when said liquid polymer binder (20) containing the microcapsules bonds with the surface of the substrate (50), upon application to the surface thereof, the substrate (50) exhibits enhanced thermal stability when the coating (10) thus applied is cured and is subjected to heat or cold.

2. The coating (10) according to claim 1 characterized in that said temperature stabilizing means (40) comprises a phase change material selected from the group of paraffinic hydrocarbons.

3. The coating according to claim 1 characterized in that said temperature stabilizing means (40) comprises plastic crystals.

4. The coating according to claim 2 characterized in that said microcapsules (30) range in diameter from 0,5 µm (microns) to 1,000 µm (microns).

5. The coating according to claim 1 characterized in that the liquid polymer binder (20) is comprised of polyurethane, the microcapsules (30) have an average diameter of from 10 to 60 µm (microns) and the temperature stabilizing means (40) is octadecane.

6. The coating according to claim 2 characterized in that the paraffinic hydrocarbon is selected from the group consisting of n-Octacosane, n-Heptacosane, n-Hexacosane, n-Pentacosane, n-Tetracosane, n-Tricosane, n-Docosane, n-Heneicosane, n-Eicosane, n-Nonadecane, n-Octadecane, n-Heptadecane, n-Hexadecane, n-Penta-

decane, n-Tetradecane and n-Tridecane.

7. The coating according to claim 2 characterized in that the paraffinic hydrocarbon has a melting point between -5.5 degrees Centigrade and 61.4 degrees Centigrade.

8. An article comprising a base material and a coating, said coating (10) comprising a binder (20) and a plurality of leak resistant microcapsules (30) dispersed throughout said binder (20), said microcapsules (30) containing a temperature stabilizing means (40) characterized in that said base material is selected from the group consisting of fabrics or fibers and said binder (20) is a polymeric binder (20) wherein said microcapsules are submerged on the surface of said base material whereby the article exhibits enhanced temperature thermal stability when subjected to heat or cold.

9. The article having enhanced thermal storage properties according to claim 8, characterized in that said microcapsules (30) are leak resistant, whereby the article may be subjected to repeated mechanical stresses with minimum changes in the thermal characteristics thereof.

10. The article with reversible enhanced thermal storage properties according to claim 8 characterized in that said temperature stabilizing means (40) comprises a phase change material.

11. The article with reversible enhanced storage properties according to claim 8 characterized in that said temperature stabilizing means (40) comprises a material selected from the group of paraffinic hydrocarbons.

12. The articles with reversible enhanced thermal properties according to claim 8 characterized in that said temperature stabilizing means (40) comprises a plastic crystal.

13. The articles with reversible enhanced thermal storage properties according to claim 8 characterized in that said microcapsules (30) range in diameter from 0.5 to 1,000 µm (microns).

14. The article with reversible enhanced thermal storage properties according to claim 8 characterized in that the coating (10) includes at least two types of separately encapsulated temperature stabilizing means (40).

15. The article according to claim 8 characterized in that said binder (20) is a polymer selected from the group consisting of polyurethane, nitrile rubber, chloroprene rubber, polyvinyl alcohol, silicone, ethylene/vinyl acetate copolymer, and acrylic.

16. The article according to claim 8 characterized in that the binder (20) is a polyurethane, the microcapsules (30) have an average diameter of from 10 to 60 µm (microns) and the temperature stabilizing means (40) is octadecane.

17. The article of claim 8, said article being a fabric characterized in consisting essentially of, in combination:

(a) a base fabric substrate (50), and
(b) a flexible polymer directly coating (10) covering at least a portion of the surface of said substrate (50), a plurality of microcapsules (30) dispersed throughout said coating so as to be covered and surrounded thereby, said microcapsules (30) containing a temperature stabilizing means (40) and being positioned on the surface of said substrate (50), whereby the coated substrate (50) exhibits enhanced thermal stability when subjected to heat or cold.

18. An article according to claim 17, characterized in that said substrate (50) is a tightly woven fabric and said coating (10) covers a portion of the outer surface thereof forming a continuous layer.

19. The article according to claim 17, characterized in that said substrate (50) is a loosely woven fabric composed of a plurality of individual fibers and wherein said coating (10) covers the entire circumference of the individual fibers forming a discontinuous layer.

20. The article according to claim 17 characterized in that said temperature stabilizing means (40) comprises a phase change material.

21. The article according to claim 8 characterized in that the paraffinic hydrocarbon is selected from the group consist-

ing of n-Octacosane, n-Heptacosane, n-Hexacosane, n-Pentacosane, n-Tetracosane, n-Tricosane, n-Docosane, n-Heneicosane, n-Eicosane, n-Nonadecane, n-Octadecane, n-Heptadecane, n-Hexadecane, n-Pentadecane, n-Tetradecane and n-Tridecane.

22. The article according to claim 8 characterized in that the paraffinic hydrocarbon has a melting point between -5.5 degrees Centigrade and 61.4 degrees Centigrade.

23. A method of improving the thermal capacity of a fabric or fiber substrate (50) characterized in comprising the steps of:

(a) applying directly to the surface of the substrate (50) a liquid polymer having a plurality of microcapsules (30) containing thermal energy storage compound dispersed throughout the liquid polymer, the polymer being present in sufficient quantity to cover and surround said microcapsules, and
(b) curing the polymer so that the polymer and the microcapsules (30) adhere to the surface of the substrate (50).

24. The method according to claim 23 characterized in that the thermal energy storage compound is a phase change material.

25. The method according to claim 23 characterized in that the thermal energy storage compound is a plastic crystal.

26. The method according to claim 24 characterized in that the microcapsules (30) have a diameter between 0.5 µm (microns) and 1,000 µm (microns).

27. The method according to claim 24 characterized in that the paraffinic hydrocarbon is selected from the group consisting of n-Octacosane, n-Heptacosane, n-Hexacosane, n-Pentacosane, n-Tetracosane, n-Tricosane, n-Docosane, n-Heneicosane, n-Eicosane, n-Nonadecane, n-Octadecane, n-Heptadecane, n-Hexadecane, n-Pentadecane, n-Tetradecane and n-Tridecane.

28. The method according to claim 24 characterized in that the phase change material comprises a paraffinic hydrocarbon having a melting point between -5.5 degrees Centigrade and 61.4 degrees Centigrade.

29. The method according to claim 23 characterized in that the liquid polymer is polyurethane and the applying step comprises spraying the polyurethane with microcapsules (30) dispersed therein on the substrate (50).

Patentansprüche

1. Beschichtung (10) mit einem Bindemittel (20) und einer Vielzahl von im gesamten Bindemittel (20) dispergierten leckresistenten, ein Temperaturstabilisierungsmittel (40) enthaltenden Mikrokapseln (30), dadurch gekennzeichnet, daß die Beschichtung für die Auftragung auf die Oberfläche eines Gewebe- oder Fasersubstrates (50) zur Erhöhung von dessen Wärmespeichereigenschaften vorgesehen ist und daß das Bindemittel (20) ein Flüssigpolymer-Bindemittel (20) ist, wobei die Mikrokapseln in dem Flüssigpolymer-Bindemittel (20) untergetaucht sind und, wenn das die Mikrokapseln enthaltende Flüssigpolymer-Bindemittel (20) sich mit der Oberfläche des Substrats (50) bei dem Aufbringen auf dessen Oberfläche verbindet, das Substrat eine erhöhte thermische Stabilität aufweist, wenn die so aufgebrachte Beschichtung (10) gehärtet ist und Hitze oder Kälte ausgesetzt wird.

2. Beschichtung (10) nach Anspruch 1, dadurch gekennzeichnet, daß das Temperaturstabilisierungsmittel (40) ein aus der Gruppe der paraffinischen Kohlenwasserstoffe ausgewähltes Phasenübergangsmaterial enthält.

3. Beschichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Temperaturstabilisierungsmittel (40) Kunststoffkristalle enthält.

4. Beschichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Mikrokapseln (30) im Durchmesser von 0,5 µm (Mikrometer) bis 1000 µm (Mikrometer) reichen.

5. Beschichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Flüssigpolymer-Bindemittel (20) aus Polyurethan besteht, daß die Mikrokapseln (30) einen mittleren Durchmesser von 10 bis 60 µm (Mikrometer) haben und daß das Temperaturstabilisierungsmittel (40) Octadecan ist.

6. Beschichtung nach Anspruch 2, dadurch gekennzeichnet, daß der paraffinische Kohlenwasserstoff aus der aus n-Octacosan, n-Heptacosan, n-Hexacosan, n-Pentacosan, n-Tetracosan, n-Tricosan, n-Docosan, n-Heneicosan, n-Eicosan, n-Nonadecan, n-Octadecan, n-Heptadecan, n-Hexadecan, n-Pentadecan, n-Tetradecan und n-Tridecan bestehenden Gruppe ausgewählt ist.

7. Beschichtung nach Anspruch 2, dadurch gekennzeichnet, daß der paraffinische Kohlenwasserstoff einen Schmelzpunkt zwischen -5,5 °C und 61,4 °C aufweist.

8. Artikel mit einem Basismaterial und einer Beschichtung, wobei die Beschichtung (10) ein Bindemittel (20) und eine Vielzahl von leckresistenten, im gesamten Bindemittel (20) dispergierten Mikrokapseln (30) enthält, wobei die Mikrokapseln (30) ein Temperaturstabilisierungsmittel (40) enthalten, dadurch gekennzeichnet, daß das Basismaterial aus der Gruppe ausgewählt ist, die aus aus Geweben oder Fasern besteht, und daß das Bindemittel (20) ein polymerisches Bindemittel (20) ist, wobei die Mikrokapseln an der Oberfläche des Basismaterials untergetaucht sind, wodurch der Artikel eine erhöhte thermische Beständigkeit aufweist, wenn er Hitze oder Kälte ausgesetzt wird.

9. Artikel mit erhöhten thermischen Speichereigenschaften nach Anspruch 8, dadurch gekennzeichnet, daß die Mikrokapseln (30) leckresistent sind, wodurch der Artikel wiederholten mechanischen Beanspruchungen bei minimalen Änderungen in seinen thermischen Eigenschaften ausgesetzt werden kann.

10. Artikel mit reversiblen erhöhten thermischen Speichereigenschaften nach Anspruch 8, dadurch gekennzeichnet, daß das Temperaturstabilisierungsmittel (40) ein Phasenübergangsmaterial enthält.

11. Artikel mit reversiblen erhöhten Speichereigenschaften nach Anspruch 8, dadurch gekennzeichnet, daß das Temperaturstabilisierungsmittel (40) ein aus der Gruppe der paraffinischen Kohlenwasserstoffe ausgewähltes Material enthält.

12. Artikel mit reversiblen erhöhten thermischen Eigenschaften nach Anspruch 8, dadurch gekennzeichnet, daß das Temperaturstabilisierungsmittel (40) einen Kunststoffkristall enthält.

13. Artikel mit reversiblen erhöhten thermischen Speichereigenschaften nach Anspruch 8, dadurch gekennzeichnet, daß die Mikrokapseln (30) im Durchmesser von 0,5 bis 1000 µm (Mikrometer) reichen.

14. Artikel mit reversiblen erhöhten thermischen Speichereigenschaften nach Anspruch 8, dadurch gekennzeichnet, daß die Beschichtung (10) mindestens zwei Typen von separat eingekapselten Temperaturstabilisierungsmitteln (40) beinhaltet.

15. Artikel nach Anspruch 8, dadurch gekennzeichnet, daß das Bindemittel (20) ein Polymer ist, das aus der Gruppe ausgewählt ist, die aus Polyurethan, Nitrilkautschuk, Chloroprenkautschuk, Polyvinylalkohol, Silikon, Ethylen/Vinylacetat-Copolymer und Acryl besteht.

16. Artikel nach Anspruch 8, dadurch gekennzeichnet, daß das Bindemittel (20) ein Polyurethan ist, daß die Mikrokapseln (30) einen mittleren Durchmesser von 10 bis 60 µm (Mikrometer) haben, und daß das Temperaturstabilisierungsmittel (40) Octadecan ist.

17. Artikel nach Anspruch 8, wobei der Artikel ein Gewebe ist, dadurch gekennzeichnet, daß dieses im wesentlichen aus einer Kombination besteht aus:

(a) einem Basisgewebesubstrat (50) und
(b) einer flexiblen, mindestens einen Teil der Oberfläche des Substrats (50) direkt abdeckenden Polymerbeschichtung (10), einer Vielzahl von in der ganzen Beschichtung dispergierten Mikrokapseln (30), so daß es von diesen bedeckt und umgeben ist, wobei die Mikrokapseln (30) ein Temperaturstabilisierungsmittel (40) enthalten und auf der Oberfläche des Substrats (50) angeordnet sind, wodurch das beschichtete Substrat (50) eine erhöhte thermische Beständigkeit aufweist, wenn es Hitze oder Kälte ausgesetzt wird.

18. Artikel nach Anspruch 17, dadurch gekennzeichnet, daß das Substrat (50) ein fest gewobenes Gewebe ist und daß die Beschichtung (10) einen Teil der äußeren Oberfläche desselben bedeckt und eine durchgehende Schicht bildet.

19. Artikel nach Anspruch 17, dadurch gekennzeichnet, daß das Substrat (50) ein locker gewobenes Gewebe ist, das aus einer Vielzahl von einzelnen Fasern besteht, wobei die Beschichtung (10) den gesamten Umfang der einzelnen Fasern bedeckt und eine diskontinuierliche Schicht bildet.

20. Artikel nach Anspruch 17, dadurch gekennzeichnet, daß das Temperaturstabilisierungsmittel (40) ein Phasenübergangsmaterial enthält.

21. Artikel nach Anspruch 8, dadurch gekennzeichnet, daß der paraffinische Kohlenwasserstoff aus der aus n-Octacosan, n-Heptacosan, n-Hexacosan, n-Pentacosan, n-Tetracosan, n-Tricosan, n-Docosan, n-Heneicosan, n-Eicosan, n-Nonadecan, n-Octadecan, n-Heptadecan, n-Hexadecan, n-Pentadecan, n-Tetradecan und n-Tridecan bestehenden Gruppe ausgewählt ist.

22. Artikel nach Anspruch 8, dadurch gekennzeichnet, daß der paraffinische Kohlenwasserstoff einen Schmelzpunkt zwischen - 5,5 °C und 61,4 °C aufweist.

23. Verfahren zur Verbesserung der Wärmekapazität eines Gewebe- oder Fasersubstrats (50), gekennzeichnet durch die Schritte:

(a) direktes Auftragen eines Flüssigpolymers mit einer Vielzahl von Mikrokapseln (30), die eine thermische Energie speichernde Verbindung enthalten und in dem gesamten Flüssigpolymer dispergiert sind, auf die Oberfläche des Substrats (50), wobei das Polymer in ausreichender Menge vorhanden ist, um die Mikrokapseln zu bedecken und zu umgeben, und
(b) Härten des Polymers, so daß das Polymer und die Mikrokapseln (30) an der Oberfläche des Substrats (50) haften.

24. Verfahren nach Anspruch 23, dadurch gekennzeichnet, daß die thermische Energie speichernde Verbindung ein Phasenübergangsmaterial ist.

25. Verfahren nach Anspruch 23, dadurch gekennzeichnet, daß die thermische Energie speichernde Verbindung ein Kunststoffkristall ist.

26. Verfahren nach Anspruch 24, dadurch gekennzeichnet, daß die Mikrokapseln (30) einen Durchmesser zwischen 0,5 µm (Mikrometer) und 1000 µm (Mikrometer) aufweisen.

27. Verfahren nach Anspruch 24, dadurch gekennzeichnet, daß der paraffinische Kohlenwasserstoff aus der aus n-Octacosan, n-Heptacosan, n-Hexacosan, n-Pentacosan, n-Tetracosan, n-Tricosan, n-Docosan, n-Heneicosan, n-Eicosan, n-Nonadecan, n-Octadecan, n-Heptadecan, n-Hexadecan, n-Pentadecan, n-Tetradecan und n-Tridecan bestehenden Gruppe ausgewählt ist.

28. Verfahren nach Anspruch 24, dadurch gekennzeichnet, daß das Phasenübergangsmaterial einen paraffinischen Kohlenwasserstoff mit einem Schmelzpunkt zwischen -5,5 °C und 61,4 °C enthält.

29. Verfahren nach Anspruch 23, dadurch gekennzeichnet, daß das Flüssigpolymer Polyurethan ist und daß der Schritt des Auftragens beinhaltet, das Polyurethan mit darin dispergierten Mikrokapseln (30) auf das Substrat (50) zu sprühen.

Revendications

1. Revêtement (10) comprenant un liant (20) et une multitude de microcapsules (30) résistant aux fuites dispersées à travers ledit liant (20), lesdites microcapsules (30) contenant un moyen de stabilisation de la température (40), caractérisé en ce que le revêtement est conçu pour être appliqué sur la surface d'un substrat en fibres ou en tissu (50) pour augmenter ses propriétés d'accumulation thermique, et ledit liant (20) est un liant polymère liquide (20), lesdites microcapsules étant immergées dans ledit liant polymère liquide (20) et, lorsque ledit liant polymère liquide (20) contenant les microcapsules se lie à la surface du substrat (50) lors de son application sur la surface de ce dernier, le substrat (50) manifeste une stabilité thermique améliorée lorsque le revêtement (10) ainsi appliqué est durci et est soumis à la chaleur ou au froid.

2. Revêtement (10) selon la revendication 1, caractérisé en ce que ledit moyen de stabilisation de la température (40)

comprend une matière de changement de phase choisie parmi le groupe comprenant des hydrocarbures paraffiniques.

3. Revêtement (10) selon la revendication 1, caractérisé en ce que ledit moyen de stabilisation de la température (40) comprend des cristaux plastiques.

4. Revêtement selon la revendication 2, caractérisé en ce que le diamètre desdites microcapsules (30) se situe dans le domaine de 0,5 µm (micron) à 1000 µm (microns).

5. Revêtement selon la revendication 1, caractérisé en ce que le liant polymère liquide (20) comprend du polyuréthanne, les microcapsules (30) possèdent un diamètre moyen de 10 à 60 µm (microns) et le moyen de stabilisation de la température (40) est l'octadécane.

6. Revêtement selon la revendication 2, caractérisé en ce que l'hydrocarbure paraffinique est choisi parmi le groupe constitué par le n-octacosane, le n-heptacosane, le n-hexacosane, le n-pentacosane, le n-tétracosane, le n-tricosane, le n-docosane, le n-hénéicosane, le n-éicosane, le n-nonadécane, le n-octadécane, le n-heptadécane, le n-hexadécane, le n-pentadécane, le n-tétradécane et le n-tridécane.

7. Revêtement selon la revendication 2, caractérisé en ce que l'hydrocarbure paraffinique possède un point de fusion entre -5,5° centigrades et 61,4° centigrades.

8. Article comprenant une matière de base et un revêtement, ledit revêtement (10) comprenant un liant (20) et une multitude de microcapsules (30) résistant aux fuites dispersées à travers ledit liant (20), lesdites microcapsules (30) contenant un moyen de stabilisation de la température (40), caractérisé en ce que ladite matière de base est choisie parmi le groupe constitué par des tissus ou des fibres et ledit liant (20) est un liant polymère (20) dans lequel lesdites microcapsules sont immergées à la surface de ladite matière de base, l'article manifestant une stabilité thermique améliorée lorsqu'il est soumis à la chaleur ou au froid.

9. Article possédant des propriétés d'accumulation thermique améliorées selon la revendication 8, caractérisé en ce que lesdites microcapsules (30) résistent aux fuites, par lesquelles l'article peut être soumis à des contraintes mécaniques répétées avec des changements minimaux quant à ses caractéristiques thermiques.

10. Article possédant des propriétés réversibles d'accumulation thermique améliorées selon la revendication 8, caractérisé en ce que ledit moyen de stabilisation de la température (40) comprend une matière de changement de phase.

11. Article possédant des propriétés réversibles d'accumulation thermique améliorées selon la revendication 8, caractérisé en ce que ledit moyen de stabilisation de la température (40) comprend une matière choisie parmi le groupe comprenant des hydrocarbures paraffiniques.

12. Articles possédant des propriétés réversibles d'accumulation thermique améliorées selon la revendication 8, caractérisés en ce que ledit moyen de stabilisation de la température (40) comprend un cristal plastique.

13. Articles possédant des propriétés réversibles d'accumulation thermique améliorées selon la revendication 8, caractérisés en ce que le diamètre desdites microcapsules (30) se situe dans le domaine de 0,5 à 1000 µm (microns).

14. Article possédant des propriétés réversibles d'accumulation thermique améliorées selon la revendication 8, caractérisé en ce que le revêtement (10) englobe au moins deux types de moyens de stabilisation de la température (40) encapsulés séparément.

15. Article selon la revendication 8, caractérisé en ce que ledit liant (20) est un polymère choisi parmi le groupe constitué par le polyuréthanne, le caoutchouc nitrile, le caoutchouc de chloroprène, l'alcool polyvinylique, le silicone, un copolymère d'éthylène/acétate de vinyle et un composé acrylique.

16. Article selon la revendication 8, caractérisé en ce que le liant (20) est un polyuréthanne, les microcapsules (30) possèdent un diamètre moyen de 10 à 60 µm (microns) et le moyen de stabilisation de la température (40) est l'octadécane.

17. Article selon la revendication 8, dans lequel ledit article est un tissu caractérisé en ce qu'il est constitué essentiellement par, en combinaison:

(a) un substrat de tissu de base (50), et
(b) un revêtement polymère flexible (10) à application directe recouvrant au moins une portion de la surface dudit substrat (50), une multitude de microcapsules (30) dispersées à travers ledit revêtement de façon à être recouvertes et entourées par ce dernier, lesdites microcapsules (30) contenant un moyen de stabilisation de la température (40) et étant positionnées sur la surface dudit substrat (50), par lesquelles le substrat enduit (50) manifeste une stabilité thermique améliorée lorsqu'il est soumis à la chaleur ou au froid.

18. Article selon la revendication 17, caractérisé en ce que ledit substrat (50) est un tissu tissé serré et ledit revêtement (10) recouvre une portion de sa surface externe en formant une couche continue.

19. Article selon la revendication 17, caractérisé en ce que ledit substrat (50) est un tissu tissé lâche composé de plusieurs fibres individuelles et dans lequel ledit revêtement (10) recouvre la circonférence totale des fibres individuelles en formant une couche discontinue.

20. Article selon la revendication 17, caractérisé en ce que ledit moyen de stabilisation de la température (40) comprend une matière de changement de phase.

21. Article selon la revendication 8, caractérisé en ce que l'hydrocarbure paraffinique est choisi parmi le groupe constitué par le n-octacosane, le n-heptacosane, le n-hexacosane, le n-pentacosane, le n-tétracosane, le n-tricosane, le n-docosane, le n-hénéicosane, le n-éicosane, le n-nonadécane, le n-octadécane, le n-heptadécane, le n-hexadécane, le n-pentadécane, le n-tétradécane et le n-tridécane.

22. Article selon la revendication 8, caractérisé en ce que l'hydrocarbure paraffinique possède un point de fusion entre -5,5 degrés centigrades et 61,4 degrés centigrades.

23. Procédé pour améliorer la capacité thermique d'un substrat en fibres ou en tissu (50), caractérisé en ce qu'il comprend les étapes consistant à:

(a) appliquer directement sur la surface du substrat (50) un polymère liquide possédant une multitude de microcapsules (30) contenant un composé d'accumulation d'énergie thermique dispersée à travers le polymère liquide, le polymère étant présent en une quantité suffisante pour recouvrir et entourer lesdites microcapsules, et
(b) durcir le polymère de telle sorte que le polymère et les microcapsules (30) adhèrent à la surface du substrat (50).

24. Procédé selon la revendication 23, caractérisé en ce que le composé d'accumulation d'énergie thermique est une matière de changement de phase.

25. Procédé selon la revendication 23, caractérisé en ce que le composé d'accumulation d'énergie thermique est un cristal plastique.

26. Procédé selon la revendication 24, caractérisé en ce que les microcapsules (30) possèdent un diamètre entre 0,5 µm (micron) et 1000 µm (microns).

27. Procédé selon la revendication 24, caractérisé en ce que l'hydrocarbure paraffinique est choisi parmi le groupe constitué par le n-octacosane, le n-heptacosane, le n-hexacosane, le n-pentacosane, le n-tétracosane, le n-tricosane, le n-docosane, le n-hénéicosane, le n-éicosane, le n-nonadécane, le n-octadécane, le n-heptadécane, le n-hexadécane, le n-pentadécane, le n-tétradécane et le n-tridécane.

28. Procédé selon la revendication 24, caractérisé en ce que la matière de changement de phase comprend un hydrocarbure paraffinique possédant un point de fusion entre -5,5 degrés centigrades et 61,4 degrés centigrades.

29. Procédé selon la revendication 23, caractérisé en ce que le polymère liquide est du polyuréthanne et l'étape d'application comprend le fait de pulvériser le polyuréthanne, dans lequel sont dispersées des microcapsules (30), sur le substrat (50).

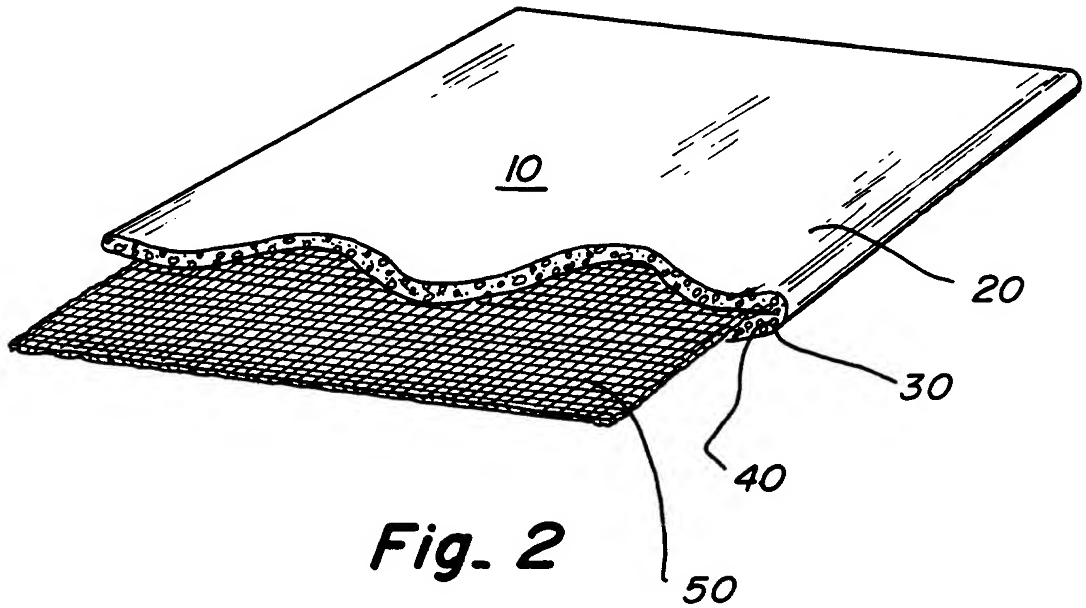

Fig. 2

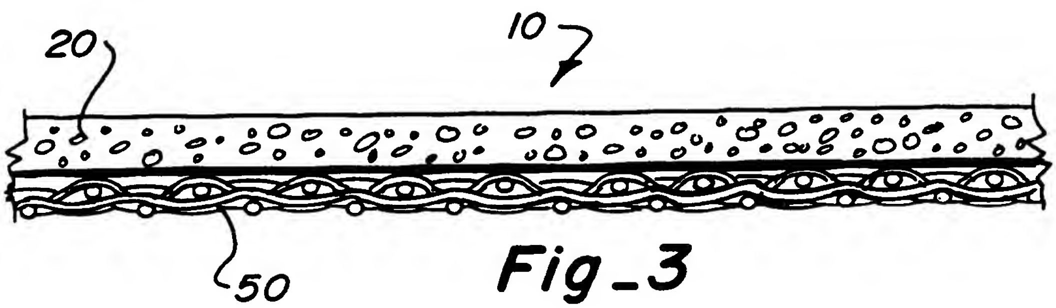

Fig_3

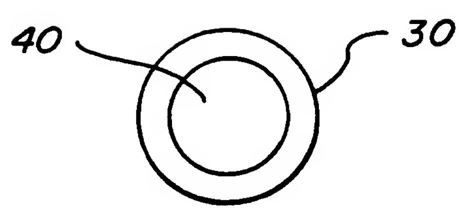

Fig_1

Fig. 4

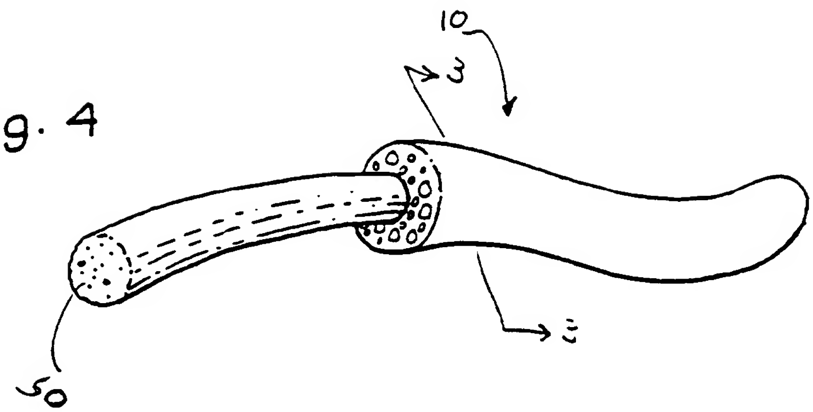

Fig. 5